NEPTUNE.

1897.	R. A. H. M.	Declination. °	Rises. H. M.	Transits. H. M.	Sets. H. M.
Dec. 1.	5 23	+ 21 47	5 24 P.M.	12 42 A.M.	8 0 A.M.
11.	5 22	+ 21 46	4 44	12 2	7 20
21.	5 21	+ 21 45	3 59	11 17 P.M.	6 35
31.	5 20	+ 21 44	3 19	10 37	5 55

ECLIPSES OF *JUPITER'S* SATELLITES, P. S. T.

(Off left-hand limb as seen in an inverting telescope.)

		H. M.			H. M.
III, R,	Dec. 3.	1 20 A. M.	II, D,	Dec. 16.	3 49 A. M.
I, D,	4.	3 13 A. M.	III, D,	17.	6 22 A. M.
II, D,	9.	1 14 A. M.	I, D,	20.	1 27 A. M.
III, D,	10.	2 24 A. M.	II, D,	23.	6 24 A. M.
III, R,	10.	5 17 A. M.	IV, D,	24.	6 49 A. M.
I, D,	12.	11 34 P. M.	I, D,	27.	3 20 A. M.

MINIMA OF *ALGOL*, P. S. T.

	H. M.		H. M.
Dec. 2.	6 45 P. M.	Dec. 19.	11 39 P. M.
5.	3 34 P. M.	22.	8 28 P. M.
8.	12 23 P. M.	25.	5 16 P. M.
11.	9 12 A. M.	28.	2 5 P. M.
14.	6 1 A. M.	31.	10 54 A. M.
17.	2 50 A. M.		

THE BRUCE PHOTOMETERS OF THE LICK OBSERVATORY.

BY R. G. AITKEN.

[Abstract.]

A paper with the above title was prepared for the September meeting of the Society, and the following abstract is now printed to put on permanent record some data concerning the instruments.

Photometer II. in principle is identical with Photometer H. described in the H. C. O. *Annals*, Vol. XI., p. 1. It consists of a double image prism, which can be moved along the axis of the telescope to any desired distance from the focus, and a NICOL prism in front of the eye-piece, which can be turned by an amount which is measured with a graduated-circle and index.

In practice, the double image prism is moved toward or away from the focus, and the whole instrument turned on its axis, until the ordinary image of one of the stars to be compared is brought as close as is desired to the extraordinary image of the other star — the two remaining images either being cut off by the eye-

stop, or being symmetrically placed in the field of view, with respect to the two images that are to be compared. The NICOL is then turned until the two images are of equal brightness, and its position is read on the graduated circle. Four such positions are found — one on each side of the two points of disappearance of the brighter image. Turning the whole photometer through 180°, the images at first neglected are brought together and a similar comparison is made. From these readings the angular distance of the point of equality of the images of the two stars (v) from the point of disappearance of the brighter star (v_o) is determined; and the difference in magnitude (M), (using POGSON'S photometric scale) follows from the equation

$$M = 5 \log \tan (v - v_o).$$

The Harvard College observers have found that "this instrument leaves little to be desired in the measurement of close double stars. Nearly all sources of systematic error are eliminated when it is properly used, and the relative brightness of two adjacent stars may be determined with great accuracy." In fact, they have found that "the results on different nights will give average deviations considerably less than a tenth of a magnitude."

A careful test of the BRUCE Photometer II., attached to the thirty-six-inch telescope, has proved that it will give results in every way comparable with those obtained with the Harvard instrument.

This photometer, however, when attached to the thirty-six-inch cannot be used to compare stars more than two minutes of arc apart.

The BRUCE Photometer I., which is a duplicate of the "New Form of Stellar Photometer," described by Professor E. C. PICKERING in the *Astrophysical Journal* for August, 1895, is based upon the same photometric principles as number II., and the method of observing and of reducing the observations is the same for both instruments. The only difference is, that only one image of each star is seen in the field of view at one time, the other two images being cut off by the eye-stop.

But in Photometer I. the double image prism, which has an angle of separation of about four inches, is placed at the focus, and two images of the object glass are formed by two achromatic prisms, which can be slid by a chain and sprocket-wheel to a distance of about forty inches from the focus. The position of these prisms is indicated by a divided wheel, which is turned by

a screw cut on the axis of the sprocket-wheel. One turn of the screw moves the prisms about three inches. The achromatic prisms are about two and one-quarter inches (6 cm.) on a side and their combined deviation is $4^c\ 23'\ 35''$, somewhat greater than that of the double image prism when they are brought near to it, but less when they are moved to their extreme position.

The simplicity of construction of this instrument insures the stability of its adjustments. Practically, it is only necessary to see that the line joining the centres of the two images is perpendicular to the edges of the achromatic prisms. If this is not the case, the adjustment is easily made by turning the tube holding the double image prism.

When the photometer is attached to the thirty-six-inch telescope and the achromatic prisms are brought as near as possible to the focus, stars about two and one-half minutes of arc apart may be compared. This is the minimum limit. The practical maximum limit is reached when the prisms are moved thirty-two inches from the focus, for at this point the diameter of the cone of rays from the object-glass equals the length of the side of the achromatic prism. In this position of the prisms, stars about twelve minutes of arc apart may be compared.

The loss of light by the process of polarization and by reflection and absorption of the various prisms used, reduces the brightness of the stars by about one and one-half magnitudes. It is, therefore, possible to measure with great accuracy the brightness of any star one and one-half magnitudes brighter than the limit of visibility of the telescope.

MT. HAMILTON, September 6, 1897.

CATALOGUE NO. II, OF NEBULÆ DISCOVERED AT THE LOWE OBSERVATORY, ECHO MOUNTAIN, CALIFORNIA.

BY LEWIS SWIFT.

The following list of twenty-five nebulæ follows No. I of fifty, discovered at this observatory and published in the *Astronomical Journal* of November 13, 1896, and also in the *Publications* of the Astronomical Society of the Pacific. Since my return to this observatory in April last, after an absence of several months, I have devoted my time to searching for comets, as well as for